A: Yes, okay.

Q: All right.

A: One summer I hired out as a farm hand all summer on an Ohio farm. My brother, who I mentioned before, had studied agriculture in high school, and he planned to raise grapes and farm on the farm that my father owned on the Maumee River. But during the procedures after my father died, that farm got sold. He bought a Dodge touring car, cut down the sides of the front seat so it would lay down and make a bed, and he started roaming all over the country. So one summer, I hitchhiked to Philadelphia and was with him there where he was working with the Fireworks Company at the Sesquicentennial Exposition. That would have been in 1925, I guess.

One summer, I hitchhiked out to the middle west where he was following the grain harvest. They start down in Texas and go all of the way up to Canada. I joined him in South Dakota, and went up to North Dakota, and then I had to come back to go to school. But the thing I remember about that, one of the men that was cutting wheat, he carried a rifle with him. He'd shoot jackrabbits on the move as he was cutting grain. He could hit them.

But anyhow, the one I really was working up to, my mother had left Toledo around 1930 and joined my brother, who by that time had settled in Las Vegas, Nevada, where he spent the rest of his life, and she spent the rest of her life. So, in 1932, that summer was the one before I graduated because I had to go the fall quarter to finish, I hitchhiked out to Las Vegas and then went on to Los Angeles and saw some Olympic games. Then, when I came back to Las Vegas, the construction on Boulder Dam they called it then, was just beginning. I figured the best way to see it would be to get a job, so I heckled the local Bureau of Reclamation man until he finally gave me a job as a rodman on a survey crew.

They were drilling the tunnels then, and we were checking tight rock in the tunnels. We had, I guess they called it, the swing shift. We'd drive out from Las Vegas in the middle of the afternoon when it was prettyhot. It got to 120 [degrees] or so in those tunnels. Then when we'd go back to Las Vegas at night, we'd almost freeze to death in the desert. It's amazing that when I retired, they found and I got credit for, I think it was one or two months, working for the Bureau of Reclamation in Las Vegas.

Q: Did that experience at Boulder Dam have any influence on your career at all? Did it push you in any direction at all?

A: No, I didn't look up the gentleman's name that hired me, but he later on was, well, even then he was high-up in the Bureau, but I think later on he became the chief engineer. He made me promise that I'd go back to school, and I couldn't keep my job. I could work there in the summer, but then I had to go back to school in the fall. But he didn't have to get me to promise that because I would have done that anyhow.

Just as a side line, Ohio State at that time, the Civil Engineering Department, put a pretty high value on surveying. So to graduate, you either had to work one summer with an engineering firm or you had to go to summer camp. The way they ran their summer camps, they actually contracted to do work. For a year or two before I was there, they were out in Yellowstone Park surveying for the government. But the year I went to summer camp, we were surveying, of course, it was a contract, too, but we were surveying state lands there. But as I say, they always thought that knowing how to survey was important to civil engineers. I don't know whether they still feel that way, but that was probably primarily due to C.E. Sherman, who was the chairman, the one that I worked for after I graduated.

Oh, did I mention one of the summers while I was in Toledo I had a job with an engineering company that was surveying for an airport adjacent to Lake Erie? We spent all of our time in water, anywhere from six inches to two feet or more deep, doing this survey. That was kind of a wet job. That pretty well ends the summer experience.

Q: A little water-logged that way.

A: Yes. I don't know whether they ever built the airport or not.

Q: I want to ask you a question about the curriculum at Ohio State. Were there any formal courses in hydrology in the curriculum for the civil engineering?

A: No, no. I think as I mentioned, we did take a course in hydraulics, which was the closest to hydrology. In fact, I don't even know whether hydrology was a term then. As I say, the course was taught in the Mechanical Engineering Department because they had a laboratory. We rated weirs and things like that. They had a channel there that we could flow water through and rate different shape weirs. I

don't know whether it was a Mechanical Engineering course or a Civil Engineering course. We also took courses in mechanics in that same department.

Q: It was some time before formal courses in hydrology as a specialty were coming into the curriculum, wasn't it?

A: Oh, yes, I think it must have been--see, that was '32. The University of Iowa had quite an extensive hydraulic laboratory. I don't know when they got into hydrology. It must have been in the '40s before anybody had courses under the name of hydrology.

Tennessee Valley Authority

Q: Okay. I also wanted to ask you about your time at the TVA. Basically, I wanted to ask you if you ever met Jim Goddard when you were there?

A: Oh, yes, sure. I can't put my finger on what his job was. He was in another division. He was in the division that handled the river forecasting for their projects, and, of course, there was one of the men in their field office that did field work for the forecasting. He was a classmate of mine from Ohio State. I knew Jim fairly well. In fact, he and one of the chief executive assistants, and another man, D. J. Brumley, out of our engineering department, had rented a house and I used to play golf with Brumley . I never played with Jim, but I got to-know him fairly well.

Q: How would you evaluate his work, his ideas?

A: I don't have any idea. I'm thinking back. I wonder if I placed him in the right place. He was not in charge. The man that was in charge of the forecasting work was not Jim. Jim was in charge of the field work. I have flashes of memory of what happened to him later on. He wrote, seems to me, reports on a new subject that was, I don't know whether it was environment or.....

Q: Flood plain management?

A: Flood plain management, that's right. I'm sorry, it may be that if I'm right about it, I got to know him more from where he was rooming rather than his work in the office. I've always kept diaries, but I can't find all of my early ones. We moved

here from Arlington in 1967, whether they got misplaced then or not, I don't know, but I sure would like to find them.

Q: Did you deal with him at all later on when you were with the Corps of Engineers?

A: I may have seen him once or twice at ASCE meetings, but I had no business dealings.

Q: Okay. You mention a little bit about what you did in high school and college in the summers. Is there anything else that you would like to amplify from last weeks discussion on that period up to 1945? I have some questions I'll ask you, but I thought I would ask you first.

A: There was one thing that, now I can't think of his name, but we had a real famous classmate that graduated from Civil Engineering in 1932. He was the commanding general of the Air Force during World War II.

Q: You mean Curtis LeMay?

A: Yes, he was a classmate of mine.

Q: Is that right?

A: But I never knew him because he had finished his civil engineering work there at Ohio State and then when I was there, he was down at Kelly Field taking his air training. But he did get his degree in 1932. I'm not sure whether he came back for the graduation or not because I wasn't with the regular group when they graduated. I had to go another quarter. But his picture is in the picture with all of the rest of the 1932 class.

Q: Well, he went on to have himself quite a career, didn't he?

A: Yes, he sure did.

Publications

Q: Okay. I want to ask you a little bit about some of the publications that you had. Now, we talked last week about some of them, like your synthetic unit hydrograph paper.

A: There's a copy of almost all of my publications in there. I had to scramble for them. I told you wrong last week. I said that the University of Wisconsin, it was the University of Wyoming that had established this repository_

Q: I pretty much thought that's who it was, because that group is pretty well-known.

A: That Wisconsin just came out. I sent them copies of all of my publications. Also a manuscript. After I retired, I continued doing some research for the Corps. I published a manuscript on it, which they chose not to publish, but I only have one CODY of that left. I sent one copy out to Wyoming, I think. But there's pretty much everything there.

Q: Well, if you would entrust me with that, I could have copies made for you.

A: Well, I don't know that you want it. It's that thick.

Q: That's all right. They'd like it for their collection.

A: You think so?

Q: I think so.

A: Of course, I submitted one.

Q: You know how the Corps of Engineers is about these things. Maybe later on if you have a copy, I could make a few more copies for you and you could have them for your use.

A: Well, if you'd like to have it, I have it handy downstairs.

Q: Okay.

A: Just a mention on the publications, there's one paper labeled "The Conception of Runoff Phenomena," which I think is the best paper, best work I ever did, and yet no one has ever paid much attention to it. Yet there's stuff in there that they're still discovering and thinking--of course, nothing is ever new. There's always something happened before, but there's some ideas in that conception there that they thought was great stuff when they discovered it recently.

Q: Now, that's the paper that you published in ***The Transactions of the American Geophysical Union in*** 1939. What led you to write that paper? Was that a product of your Pennsylvania work?

A: Well, it was also, I mentioned before, that when I was with the Geological Survey, I developed this idea of this third-type of runoff, of the sub-surface runoff. It was not until '39 that I had a chance to really present it. The synthetic unit graphs came out fast, but it was another situation. So it was '39, when, by that time, all of the research I'd done while I was with TVA and the Pennsylvania studies just came together, I had a rather 'more complete picture of the runoff phenomena.

In other words, when I was down at TVA on weekends, if it was raining, I used to go up in the mountains and watched the water to see where it came from. You could see the places where the surface runoff goes off quick. But after the stream had gone down, the water would still be coming out of the banks, coming out of the ground, but coming out rather quickly. That was just a verification of that subsurface runoff that comes off in between the surface runoff and the ground water runoff. But, I was ready by that time to put out my ideas.

Q: Now, most of this work was research that you did. It was, basically, office work and then you went out and you verified it by field observation?

A: Well, I always say, my hobby was hydrology as well as my work, so I did an awful lot of it on my own time.

Q: You seemed to spend a lot of time outdoors in going, working in farms, and surveying. Did that contribute to your ability to observe these natural phenomena?

A: Oh, yes and no. I think that being out was more sort of vice versa, more of the result of my wanting to observe, rather than being out developing my desire to observe. It was just because of my analysis of the situations that I wanted to verify things. You can sit in an office and theorize for time immemorial, but it pays to go out and see what's going on, too.

Q: Okay. Let me ask you about another paper that you did for the AGU *Transactions* and that was the one you did in 1940, "Predicting Headwater River Stages Directly from Precipitation."

A: That was just an empirical thing that I developed while doing those flood forecasting procedures in Pennsylvania. What did you say the date was?

Q: It was 1940.

A: Yes, that was during the time I was in Pittsburgh. We had basins where we would have rainfall information and river gauges, but no discharge information. So this was rather empirical, it didn't have any scientific background. It was just, you did this and you got certain results. There wasn't any scientific basis to it, but there seemed to be a relationship. You could analyze it and, I guess theorize as to why it worked, but it did help in forecasting stages in places where we didn't have any discharge information. But it never received any notice or anything.

Q: All right. Let me take you to another paper. This was in *Transactions of the ASCE* for 1940, and that's your paper on flood routing.

A: That was work. That was my official work at Knoxville.

Q: Okay. So that was your TVA?

A: There were two other joint authors on that, who were in the same branch I was in.

Q: So that came from your TVA work?

A: Yes.

Q: You won a medal for that one.

A: ***Yes,*** I did. W .G. Hoyt was the man that I worked for in the Geological Survey. He always encouraged me and helped me out. He probably had something to do with me getting the medal.

Q: Now, what was the primary thrust of this article?

A: It was operating the TVA system of dams, because the way they worked, when they were under normal power operations, each dam had a pool behind it. But then during flood times, they gradually would open up their spillways and the river would convert from a series of steps into an open river condition. These were routing procedures, and the flood wave would move through those areas. They were deeper than they would normally be, and the flood wave would move through there faster than what you would expect. These routing procedures were developed almost primarily for the TVA system. I don't know that anybody ever tried them anywhere else.

Q: So it's primarily to keep the releases under control then so you wouldn't get certain river stages too high?

A: It was more to find out what the levels would be, because when the flood got real bad most of the main stream dams would be opened as much as they could open them so they wouldn't be causing backwater. But Chattanooga got flooded every once in awhile. It was more for use in studies. I don't know that the flood forecasting people ever used it. We were in a different branch from the people doing the flood forecasting. I think Jim Goddard was in charge of their field work, and I mentioned that Dembowski (also at Camp Rocking) from Ohio State was in the field. I think Jim was in charge of that sort of thing.

Q: I also noticed that you had a number of discussion papers that you submitted, or had submitted, to the ***ASCE Proceedings*** in '35, '38, '39, 40, '41, and '44. Do you recall what the primary subjects were and why you wrote those articles, those discussion comments?

A: They would all have been in the field of rainfall and runoff relations, flood routing, or flood forecasting, that sort of thing. Writing a discussion of a paper is a way of getting some of your own ideas out in the open, too. I'm sure that's what most of

them were, although sometimes somebody will ask you if you would write a discussion. I don't remember the motive behind them all, but I imagine in most of them I had something I wanted to say, in addition to discussing the paper.

Q: Well, your record of publication, less than 10 years after you graduated, is quite large. I mean I'm sure compared to most of your colleagues, you far exceeded them in the output of your work.

A: The output, yes.

Q: That's not something I would expect to be normal for a lot of young engineers who were just working their way into the profession.

A: I don't know why. It might be because W .G. Hoyt, you know, encouraged me to do that sort of thing. Well, I guess it was selfish, too. I guess when a person writes a paper, he wants to get a little credit for it.

Q: It's a good reason. You want to get your ideas out.

A: Certainly, it's one way to advance your career. Of course, in the university teaching profession, you have to do that. What do they say, "Publish or die?"

Q: "Publish or perish." In some cases we used to call it, "Publish and perish." I notice a number of your articles appear in the *Transactions of the American Geophysical Union.*

A: I think maybe you could get through quicker and smoother than ASCE. You would get your paper approved and then present it at the annual meeting and it would be published. Also, the AGU was deeper into hydrology than the ASCE. I also participated on a number of committees for both the ASCE and AGU. I still belong to the organizations, although most of them I'm some sort of honorary member so I don't have to pay dues or anything anymore. But I see these instructions on what you have to do to submit a manuscript. I suppose it's easy for someone that's up on all of the modern methods of reproduction and whatnot, but they sound awful confusing to me.

Q: Well, almost everything is done on computers now. Send a little disk in, you know. That's the way it is. Modern technology. What was the influence of an organization like the American Geophysical Union? Do you think they had a lot of influence in the development of hydrological science?

A: Yes, I think I mentioned before, one of the consultants on that U.S. Geological Survey project that I started out on was Robert E. Horton. He was the top man in hydrology. I don't know whether they called it hydrology when I joined in 1935. But that's probably where the name, more widespread use of the tern-i hydrology was due to the American Geophysical Union. He would come to the AGU, when I was working for the Geological Survey. They held their annual meetings in Washington at that time and we could go to them and you got to know all of the people.

I can still see Robert E. Horton come striding in with a cigar. He was quite a character. He was a real smart man. He had a lot of odd characteristics, but he was quite a scientist. He made his money, he was a consultant when the Great Lake states, there was a big case back in, I guess in the '30s, when the states were suing the federal government on the amount of water being diverted at Chicago and he was a consultant in that case. I understand that's where he did well financially so that he was able--he had a private hydraulic laboratory up in New York State, and he did a lot of private research. He was quite interested in hydrology. He wrote a lot of papers in the field of hydrology. They say that when he was busy, he'd stand in the middle, he had two or three secretaries, and he'd be dictating to them all at the same time, keeping them all busy.

Q: So he was one of the prime people involved in developing hydrology as a science?

A: Yes. When he died, he left, I don't know how much, but the American Geophysical Union has two prizes that they award each year from the funds that he left. He left part of it to the hydrology section, and part of it to a general fund, I think. Then each year they award, I don't know how much money is involved, but they have a Robert E. Horton Award each year.

Q: Do you think that that work that was done in the American Geophysical Union then helped to influence the development of hydrology in organizations like the Corps of Engineers?

A: I think so. In the beginning, I don't think there were too many Corps people involved. But they were as time went on. The publications were probably utilized.

Ralph Wilson out of our branch in the Chief's Office was active in it, and he was general secretary for years of the International Association of Scientific Hydrology until he died.

The American Geophysical Union is related to the International Union of Geodesy and Geophysics. The AGU is the U.S., I don't know what you'd call it, the U.S. body that participates in the International Union of Geodesy and Geophysics. They have a big meeting about every four years. One of these papers I delivered in Brussels in 195 1 before the IASH of the IUGG.

So the AGU was, I guess to answer your question, they certainly were in the forefront that brought hydrology to the recognition that it has. Even now, they're still talking like they have to make a science out of it. But then in the international field, all of the other countries had people who were getting interested in the same subject called hydrology.

Q: A lot of the issues that you addressed in hydrology had really not been well-addressed by major engineering organizations like the Corps of Engineers, had they? I mean they really hadn't studied those subjects and brought them forth in their planning and surveying process.

A: Well, up until 1942, I don't know much of what was going on before. Most of the engineering design of hydrologic features were based on empirical relationships, such as CIA for urban storm runoff. But shortly before I went over in '42, that's when Hathaway got them involved in designing the spillway capacities on an adequate basis. I suppose that got all of the field offices involved. They had to start digging into that subject. But I can't really say what they were doing before 1940. But from then on the people involved in the district and division offices were probably in the hydraulics section or division, but they certainly had people start working on hydrology.

Q: Okay.

A: Is Bob Pafford on your list?

Q: No.

A: Up until two years ago I exchanged Christmas cards with him. Mrs. Snyder always took care of Christmas cards and did a real good job of it. So when she was ill, we didn't get any out in '93, and '94. When you don't do that, you stop getting replies from other people. So I haven't heard from Bob Pafford for a year or two. He wasn't Chief of the Engineering Division, but he was number one man in the field of hydrology and hydraulics in the Missouri River Division. He retired and went to work for the Bureau of Reclamation for awhile out in California. That's where he was living the last I heard from him, but he was quite a live wire.

Q: Do you know what area in California he was living in?

A: Well, I have his address.

Q: Do you? Okay. Maybe I can get that from you later.

A: Okay. Each of the division and district offices ended up with quite satisfactory hydrology people. It was sometime later on when Roy Beard went out to the west coast and started working up computer programs for different hydrologic functions, flood routing and that sort of thing.

Q: The Hydrological Engineering Center?

A: Yes. That really put the Corps' name in the public eye. I get these notices, you know, everybody's giving seminars these days. You almost always find, in this field, you'll find that they'll be discussing one or two of those programs worked up by the Hydrologic Engineering Center.

Q: You had mentioned before the importance of Merrill Bernard to your career. What other now essentially famous hydrologists did you work for in the early '40s?

A: I mentioned that an engineer from St. Louis, W. W. Horner, was one of the consultants on that Geological Survey project. He had an engineering consulting firm, and there was a chap in his office that wrote papers on the unit hydrograph. I don't know that I knew him though. I mentioned before the chief engineer of the Pennsylvania Water and Power Company, who was active in the AGU. I met him through the AGU meetings. He was quite interested, ahead of his time for a private

firm like that to be interested in hydrology. It was unusual at that time because almost all of the activity was university or government.

Q: When the war in Europe ended, we talked about. . .

A: Let me say, and I don't know whether you have that or not, but Al Cochran gets a lot of credit for that Hydrologic Engineering Center. He's the one that Roy Beard worked for when he came into our office for awhile from one of the field offices. Roy might have spurred him on, but Al Cochran is the one that planned, and set up, and got approval from the Chief's Office to set up that Hydrologic Engineering Center.

Civil Works

Q: Now, after the war, after your time in the Rhine Flood Prediction Service, you came back to the Corps of Engineers again, and you returned to work for Hathaway in Civil Works.

A: You probably know, Hathaway got the Legion of Merit for his work on the Rhine River project. He became a special assistant to the Chief, and Al Cochran then became head of the branch. I actually was under Al Cochran then, although I was Hathaway's suitcase carrier from then on. I don't know whether you want to get into that now, but. . .

The Saint Lawrence Seaway

Q: That would be fine, sure.

A: The St. Lawrence Seaway was being constructed, and Hathaway was a Corps' representative on the Lake Ontario Board of Engineers. They always have a working committee, so I was on the working committee. Then after the studies were completed for the operation, the Board and working committee were working primarily on operating studies for the project, he became a member of the St. Lawrence River Board of Control. Each week, the Board approved the operating plan for the dam controlling the outflow from Lake Ontario. It was mostly routine. But there again, I was on the working committee. Then when Hathaway retired and went to the World Bank, I became a member of the Board of Control. You'll find a picture in there when I resigned.

It was interesting. I retired in '66, and it was '74 before I got kicked off of the Board of Control. What happened, and I was joking when I said I got kicked off, but I did have to resign. The North Central Division Engineer is always a member of these International Joint Commission (IJC) committees and boards. The Chief of Engineers had a representative, which meant the Corps of Engineers had two people on this board and on the St. Lawrence River Board of Control, but the U.S. Seaway Authority, that was actually operating the project, didn't have a representative.

So how they left me on there for, let's see, eight years, I don't know. But finally, it was so obvious that the Corps wasn't entitled to two people on the board with the operating agency not even being represented, so it was in '74 when I resigned from the Board of Control. The Corps was writing my travel orders and everything, and paying my subsistence.

Q: Let me ask you now. What were you doing with Hathaway on the St. Lawrence? What kind of studies were you doing?

A: Well, we had almost a hundred years of record on the lakes. You'd think it would be easy to use forecasts, particularly with all of the storage in the various lakes. The project was supposed to raise minimum levels and lower maximum levels on Lake Ontario. The new dam project dam was way down the St. Lawrence River, but the control of the river actually backed up and controlled outflow from Lake Ontario, the amount going out of the lake and the inflow control the level of Lake Ontario. So an awful lot of our time was spent in running that hundred years of record with different restrictions on how the project could be operated, and setting up a plan of operation that would meet the requirements of raising minimum levels and lowering maximum levels. This is jumping ahead of the story, but the Lake Ontario Board of Engineers submitted their studies to the International Joint Commission in 1957. I don't know whether you are familiar with the IJC or not. They meet in the spring in Washington and in the fall in Canada. All the Boards that they have report to them at the meetings. In the meantime, the Saint Lawrence River Board of Control took over the responsibility for further regulation studies. Regulation of Lake Ontario began in 1960.

Of interest is that in 1962-63 a more critical dry period occurred and in 1985-86 a more critical wet period occurred than had happened in the earlier 100 years. Deviations from the operating plan had to be made. You would think it would be easy to use forecasts in operating, particularly with all the storage in the lakes, but because of the storage successful forecasts of the rainfall would have to be for periods longer than are possible.

Starting over again, there was a Coordinating Comrnittee on Great Lakes Basic Hydraulic and Hydrologic Data composed of three representatives of Federal agencies in each country having responsibilities for such data. Hathaway was Chairman of the U.S. Section. The Committee collated data in Canada and the U.S., adjusted the lake inflow and levels to present diversions and channel conditions. I took that job, too, when Hathaway retired. The group also provided an acceptable set of data for the regulation studies. They established an official network of stations that Canadian agencies, and the Lake Survey, agreed to maintain and publish the records. They were published. The stations were also used in the forecasting, but that was done by an Operations Advisory Group that prepared each week's operating plan.

In the original studies, the Canadians, who did most of the computations, started doing it manually. It was a backbreaking job. We worked with monthly data. But to run a hundred years by hand to test an operating procedure is quite a lot of work, and the Canadians began to work out a computer program where they could speed-up the procedure.

In the meantime, though, I had ideas on how to do it, too. So with help during their spare time of a couple of people in the office, I ran through a proposed method of operation. I introduced some--they wouldn't accept forecasting--but I introduced some ideas that really were sort of forecasting. Some of the decisions were made on the basis of forecasting based on past relationships. We ran through the hundred years of records. Well, that sort of broke the ice, so then the Canadians did another study and went further into that sort of predicting business. Their plan was the one we finally adopted.

Q: Was their use of a computer program something pretty new at that time? This was 1950 sometime?

Computers

A: Yes, it was just getting started though. I have an interesting story for you about the Corps' computers. I think the Corps was, other than the Army who had the big Univac, one of the first government agencies to get into the computer business. Colonel Whipple, the executive officer in the Civil-Works Division, was a really smart man. He was too smart, actually, because he was in an executive position, but he sometimes tried to do our engineering work for us, which didn't go over too well with the engineers.

But he was interested in computers, in getting into computing work. I'm kind of a stick-in-the-mud. I don't like to change too much. I didn't think too much of the idea. At that time we had a program we called Civil Works Investigations. We got a little money each year for research, but we could not call it that. It was parceled out. The districts and divisions would propose projects, and they would get a little bit of this money to do the investigations.

Colonel Whipple thought we should get into the computing business. I didn't argue with him. So he wrote a contract with [John] von Neumann, the father of computers. He was consultant to us for a few days. We had a big meeting here in Washington. The two divisions primarily involved at that time were the North Pacific, who operated all of the Columbia River dams, and the Missouri River Division, with all of their dams. They were all in here. and Von Neumann heard what their problems were and he thought computers would certainly be useful. So then both of the divisions got money to work on computers. They both ended up with computer programs to operate their projects. I think they were ahead of the game. I don't know of any government agency that really got involved that much that early in the business. I have copy of a July 1952 letter assigning CWI money to field offices for Electronic Computers.

Mississippi Basin Model

Q: Gail Hathaway went to be a special assistant to General Wheeler when he became Chief of Engineers.

A: Yes, I think that's probably about the time. One of my activities was the Mississippi Basin Model Board. Should we get into that now or not?

Q: Well, sure.

A: That was an interesting assignment. After WES made some of these studies for the model, the recommendations came into the office and some reviewers recommended against it. General Reybold said, "Build it." That's all, there was to it. He just told them to do it. You know, the recommendations were pretty much against it.

Q: Now was that the one that was started during World War II with the German prisoners?

A: Yes, they had German prisoners as labor to do the rough grading of the land. During the construction and after it was operational, the Model Board consisted of the pertinent division engineers, the Waterways Experiment Station director, and a representative of the Chief of Engineers. Hathaway was the Chief's representative, and I was on the working committee. We met probably a little more frequently than the board did to work with the Waterways Experiment Station on the design and completion of the model.

When Hathaway left, I think, I'm not really sure, but I think I took his position on the board. The Mississippi River Commission make an inspection twice a year, and I have a picture there of everybody standing on a steamer, and I'm one of them. I remember when the Model Board arranged this particular trip. None of the working committee are in the picture, and I was there, so I must have been on the board, or at least a representative of the Chief.

Q: Well, tell me what were you doing with the model? What were the major concerns?

A: Well, the instrumentation, primarily. The type of resistance they were using. There was still foot dragging by some of the field offices. They thought that they could--by this time, the computers were in wider use, and they thought they could do just as good using their computers as they could on the model, but that opposition gradually disappeared. The model was used a lot for verification of levee designs and things like that. Up to the time I left, I don't remember any major floods.

By the time I left, it was sort of mothballed. In other words, it was put in a standby. They quit using it for design studies and sort of put it in a standby position. But then several different times for major floods it was placed back into operation. It did a lot of help in showing which areas might be subject to flooding so that the people doing the emergency sandbagging and everything had a lot of help in where they could spend their efforts most profitably on the floods. I don't know whether it's still in 'a standby position or not.

Q: No, I think it's largely gone. Most of it, I think, has disappeared. There are parts of it that are still there. Not used for much, but I think they still have it there, as far as I recall.

A: Yes.

Q: I've been down there a couple of times.

A: I made a lot of trips down to Vicksburg, of course, when we were working on that.

Q: Do you remember any major technical problems with the model? Or any disputes, philosophical disputes, or scientific disputes?

A: Well, no, what resistance there was was subdued. There were always the problems of how best to get the measurements during the tests, and the Waterways Experiment Station did all of the real work on the design of the instruments and channels. But that was always a problem to be able to record all of the information when they were running a test. It was set out so they could use pieces of it. They didn't have to use the whole model at one time. They could operate one section of it at a time

Q: Whatever part they were interested in?

A: Yes, particular when they were doing design work for the field offices. There were inflow points off every tributary. The model didn't go very far up into any of the tributaries, except maybe one or two of the major tributaries. So the field offices had to supply, for whatever study and even for the floods, the field offices had to supply what the inflow was at all of these points where water was coming into the system. So the field offices had, particularly during a flood, a major job to supply that information. When a particular office had a study being may, why they had to submit that information to the Waterways Experiment Station before they could run the experiments. They had to know what was coming in at all of the inflow points.

Q: You mention the inflow. What were the changes in the way that those kind of measurements were taken? Did you basically use the same kind of gauges over the years?

A: Are you talking on the model now?

Q: No, on the rivers themselves, where the district would say measure the inflow from a tributary to the Missouri River.

A: Oh, they all had operating and forecasting procedures for their own rivers so they, other than just the work of doing it, there was nothing new. In other words, they

were prepared to supply that information under whatever conditions were wanted. That goes back to the network that was set out with the Weather Bureau and Geological Survey, but even though the Weather Bureau was the official government agency for river forecasting the Corps always sort of did their own, too.

Q: You said Hathaway's gauges were critical to all of this?

A: Well, I was thinking of the program that he set out for the recording rain gauges which were not involved in the model. But by that time the Geological Survey was operating a lot of stream gauges for the Corps.

Q: Let me ask you since we talked about it, about WES itself, the Waterways Experiment Station. When did you first work with WES and get to know what they were doing down there?

A: Well, it would have been, I've tried to think whether I, I ever had any real business with them before the model or not. I don't remember. I reviewed their reports, in design studies that came in from the field offices. They did a lot of work on spillways, and on levees, and that sort of thing. I'm sure I was familiar with their work and reviewed their reports. But I don't believe I had much business with them until the model got started.

Q: Did you know Joe Tiffany?

A: Oh, sure, sure. He was the key civilian. I have a letter from one of the directors, who, when he left, wrote a real nice letter to me.

Q: How critical was Tiffany to the success of WES?

A: Well, of course, I don't have any personal experience, but I would say he had a big hand in it. Even after he retired, he was still a consultant to them, wasn't he?

Q: Yes.

A: I would say he had, I don't know whether he was better in administration or in technical, but I suspect he was pretty good atboth. There was one of his assistants.

I don't remember his name, but that's another story. He got a, because of a special activity there, he got a P-16 rating for his activities there. Just before I retired, I sold the office on getting out of, not that I was doing much administration, but getting out of the routine work to do some special research in rainfall and runoff relations to get a 16. Civil Works approved it, the Chief's scientific adviser approved it, and the Chief of Engineers approved it, but the guy in charge of personnel didn't like the idea. He never did let it go through.

Q: Yes, some of my favorite people are in personnel offices. I imagine they must have been favorites of yours, too.

A: Yes, yes.

Headquarters, United States Amy Corps of Engineers

Q: Okay. Let's go back to the Corps of Engineers. So Hathaway went to this other job and Al Cochran replaced him as the head of what, the Hydraulics Branch?

A: Yes, he replaced him as head of the Hydrology and Hydraulics Branch when Hath became special assistant. So he'd been in there for some time when Hath went to the World Bank.

Q: So that was some time after the war, some years.

A: Yes.

Q: So that Hathaway was head of the Hydrology and Hydraulics Branch in the Engineering Division, and Cochran and you, and who else worked for him in that Branch?

A: Oh, of course, that changed over the years.

Q: Well, I mean the key people.

A: Well, Mark Gurnee, he worked there for just awhile until they found a better job for him when he came back from the war.

Q: He went over to Construction and Operations?

A: *Yes,* he became Chief of Operations. I don't think he did right away, but he eventually did.

Q: No, eventually, *yes.*

A: He passed away. He was a good friend of ours, I mean my wife and his family. After he retired, I used to play golf with him until he moved up to New Jersey. First his wife passed away and then Mark passed away a couple of years ago. Roy Beard came in and out. Bryce Hobbs, who's still living here. He's older than I am. He was a sedimentation man. He came in from one of the field offices. He came from Arkansas, the same place Al Cochran came from. I think they went and played football together. Later on, Hagen came in.

After the war was over, another chap came in. I don't know whether you're interested or not, but I think he was in my section. I was Assistant Chief in charge of the Reservoir Regulation Section where we reviewed all of the plans for reservoir operations. The districts had to submit their plans through the divisions for operating the reservoirs, and the Chief's Office approved them. Then in Section 7 of the 1944 Flood Control Act, Congress passed a law that any dam built with Federal money for space for flood control had to be operated in accordance with plans approved by the Secretary of the Army. He designated the Chief of Engineers to execute his authority.

Being in the Reservoir Regulation Section, we handled this. This included a number of the Bureau of Reclamation dams. We had several private dams built by river authorities that we issued regulations for. This was sort of a diplomatic job. The field offices had to work with the people that were operating the dams and work out a mutual agreement as to how the flood control storage should be operated. These were submitted to our office for review, and then the Chief would submit them to the Secretary of the Army for approval. They would be published in the *Federal Register.* That was part of the branch's work; part of the time we reviewed the hydrology studies for the different projects.

But this chap I was trying to think of his name, he came back from the war and ended up in my section. He was deeply interested in transmitting materials in pipelines using a fluid transmission. That's all he worked on. We couldn't get him to do any of our work. So finally he moved on to something else.

We had a draftsman, Charlie Pletcher He was a jewel. Anytime you wanted something or you wanted something done by other parts of the office, he would arrange it for the branch. Anytime you needed something, why Charlie could take care of it for you. He eventually left because he got into more professional work in one of the other branches. He's been long retired. I still correspond with him. He's up in State College in Pennsylvania. But he was a big help to the office.

I'm trying to think of the name of the man that was the chief after Al retired. It was Verle Farrow. He was a hunting dog fancier. He raised dogs and acted as a judge at trial meets.

Q: When did Al retire, in the '60s sometime, wasn't it? Did he retire before you left or after?

A: No, it was after. It must have been probably at least '70, I would think. We visited them and still correspond with, or my wife did with his widow. She lives in Columbia, South Carolina. They were the ones that brought the champagne back from their trips. Colonel Lyles that I mentioned being in Paris had a consulting-engineering business in Columbia, South Carolina, and Al went down there to work for him.

But when Al retired, one of the men in the branch, Verle Farrow, succeeded him. This was, of course, after I had retired. It was a number of years afterwards. I don't know whether there was someone else in there, between him and Hagen or not. At some point after I left there, they combined hydrology and structural hydraulics with Douma still in charge of hydraulics and somebody in charge of both.

Q: I know Jake told me that he didn't want the job as far as running the hydraulics and the hydrology branch. He just stayed with hydraulics.

A: Yes, I don't know how that worked out. I think maybe they had originally been together and they separated them. That was before my time.

Q: They have separated them since.

A: Again, they're separate?

Q: I guess they are, yes. One of these things that comes back and forth. What was Al Cochran like to work for? You worked for him for a long time.

A: He was fine. He didn't have a selfish bone in his body. He would push, help anybody get ahead regardless. But, like everybody, he had some characteristics. If someone was out of favor with him, why, he kind of gave them a bad time. But, I never had any trouble with him. He was very good at planning and writing up proposals and projects. He never worried about someone getting into his territory. I had a [GS] 15, the same as he did the last few years there. This was based on special considerations in that I represented the Chief's Office on a lot of foreign things, and did a lot of things outside of the office, and, as I say, he supported that fully.

Q: You were like a senior consultant in the Corps.

A: Well. ..

Cop Consultant

Q: Besides running whatever. ..

A: I don't know whether you'd call it consultant. I represented them on, well, on the St. Lawrence, on the Mississippi Basin Model Board. I got, fairly early, into the international business. I was the representative on the Commission on Hydro-meteorology of the World Meteorological Organization--that was new to the Meteorological Organization. They set up the commission and the meteorologists couldn't stand calling it hydrology, so they called it hydro-meteorology .

It was organized at a big meeting here in Washington, and the U.S. had three representatives on the commission. The main one was the Weather Bureau man, here was one from the Geological Survey, and I was the Corps of Engineers member on that. That went on for years. I don't know how many times I went to Geneva or other places for commissions or working group meetings. Mrs. Snyder went with me on a number of times.

I remember one time when we were in Geneva, it was just after the Russianshad invaded Czechoslovakia. The Russians were always at these meetings. They loved to give parties and see how drunk they could get you. But word came to us to show our disapproval. At that time there was a Water for Peace Program on. I don't

whether you ever heard of it or not. But a friend of mine was the President's representative on Water for Peace. He came to Geneva and brought us the word that we couldn't go to the party, except for one official representative. The U.S. Weather Bureau man, Max Kohler, was president of the Commission. So he went to the Russian party, but none of the rest of us could go.

It was interesting, I've forgotten the details, but the commission, at one of their meetings, were voting for an officer. One of the candidates was a Russian I think they took secret ballots. But the Czechs were there. They were represented on the commission. They had no love for the Russians. I forget the details now, but it was quite interesting to see how that voting came out.

The International Hydrological Decade

Q: So you got involved in a lot of these international political squabbles?

A: Some. Then there was a ten-year program that was called the International Hydrological Decade. I was a member of the U.S. Committee for one term. I was on working committees also. It was sponsored by UNESCO, an organization of the United Nations with their headquarters in Paris. So when we had meetings in Paris, why we met at the UNESCO building, which was on the Left Bank. There were a lot of nice little hotels around there to stay at. We had one meeting in well, it's St. Petersburg now. Back then it was?

Q: Leningrad.

A: Leningrad. We met there, I think, for a month, or at least two weeks. I was joint chairman with a Russian engineer of a committee on floods. We organized at that UNESCO meeting in Leningrad. We stayed at the Astorid, I believe, the hotel that Hitler had picked out for his hotel. He never quite made it.

Q: No.

A: But there was always a flower arrangement in the rooms. The fellows would come in, and they'd go over the flowers, "Testing one, two, three." Oh, we had a meeting there at the house where Rasputin was poisoned. It was just a few blocks from the hotel. I don't know why we would be meeting there or not.

Q: Well, those kind of things have been taken over by the Communist Government.

A: We heard all of that story. But the main thing I remember is when I made my travel plans, there wasn't time to go to Moscow. But after we got there, they shortened the meeting, and they planned an excursion where we traveled by bus from Leningrad to Moscow and stopped at one of their hydrologic laboratories out in the field. It was about half way between Leningrad and Moscow.

So a week or two before, I went to the travel agent to change my, Mrs. Snyder was with me, to change our trip to include, instead of flying from Leningrad back to the West, to go to Moscow first and fly from there. So about a week later I went back and they said, sorry, they couldn't do anything about it. I'd have to wait until I got to Moscow.

So as soon as I got to Moscow, why, I went to the Aeroflot office and told them what I wanted to do. We had a friend, he was the commercial attache in Bonn that we wanted to visit. So in reorganizing the trip, I eliminated one trip across the continent so I shortened our travel a whole lot. When I went back to get my tickets, they changed everything the way I wanted it and then they told me how much I had to pay. I said, well, I felt that since I eliminated a thousand miles or so of flying that there hadn't ought to be any charge. I said, "What happens if I don't pay?" She said, "Well, you won't leave Moscow."

It was an interesting thing though when we landed in Vienna, we just sort of had a feeling of lightness or a feeling of relief or something. When we were in Russia, there it wasn't quite as bad as it was a little earlier. I remember hearing one man give a talk where on a trip he made, everywhere they went, there was a, what do they call, the secret service people they have. ..

Q: The KGB.

A: Well, anyhow, they had a government man with them. In one place, the man said they were looking at a dam or bridge and he started taking a picture and the guide said, "You're not allowed to do that." He asked her, "What if I do?" She said, "I don't care. All I'm supposed to do is tell you you're not supposed to do it." He also said that one morning when they got up, or the night before they went to bed, they said, "We're going to give you a real American breakfast in the morning." So they had hot dogs and Coca Cola.

But when we were there, we didn't have anyone following us all of the time. We just were never sure about what the security was. But you could take a taxi and go places by yourself. We went through the art museum. That was in Leningrad not in Moscow. But when we stopped at that hydraulic laboratory, the wives of the staff there took Mrs. Snyder on a mushroom hunt in the woods. That night at dinner, they made a great howdy-do about serving us those mushrooms. Mary was afraid of them so she said, "Well, how about sharing them with the rest?" They had brought them to the table where the English-speaking people were. The French table, they were very eager for the mushrooms. I think Mary got rid of them without having to eat any of them.

Q: The Russians are pretty generous with that kind of stuff though, basically.

A: Yes, when we got to Moscow, we went to the new hotel near the Kremlin. I think it was the largest hotel in the world at the time. They had one wing of it, one part of it finished. The rest was not finished. I don't know how, I think it took us an hour to get registered. Stand in line, and the kind of equipment they had. The cash registers they had were out of this world.

At the official meetings in Leningrad at the hotel, they set up a special restaurant for us. It didn't matter much at dinner, but at lunch time, you couldn't get in there and out of there for less than an hour-and-a-half. We figured that the waiters must come and take the orders, and then they must go back and do the cooking. But I'm sure they didn't, but that's what it seemed like. It was terrible, the time it took. The food was all right, but the service was just out of this world.

Q: Service is not part of their business.

A: **No**.

Q: I was there in '93, and it's not very good.

A: The thing that's really interesting about this, of course, we were getting a per diem and UNESCO, this was a meeting sponsored by UNESCO, although I think WMO might have been jointly involved.

Q: I'm going to stop you just for a minute.

A: So, without anybody knowing about it, UNESCO paid us our expense money in rubles. When I signed up for this trip to take this excursion, which they had arranged because of the changing of schedules, to go from Leningrad, to the laboratory, to Moscow, they wouldn't take rubles. Had to give them dollars. So I had rubles coming out of my ears. I had brought dollars,_ figured I'd be spending dollars. But one of the chaps at the meeting, he must have heard me joking about it, he was in a position to spend rubles so he took, I don't know how many, some rubles off my hands. He sent me a check later on for them. But we still'had a lot of rubles, and so we bought a lot of canned fish eggs.

Q: Caviar?

A: Caviar and stuff like that. They had foreign shopping stores, where you could only spend dollars, too.

Q: They don't have many any more, I'll tell you that. They don't have much of that any more.

A: I don't suppose, but we bought a lot of little toys and gifts, and things that we brought home to get rid of those rubles.

Q: Yes, it's not in a very good condition there, the last time I was there. They're not doing too well.

A: That's a shame.

Q: What about the quality of the Russian hydrology and civil engineering that you saw from those trips? How good was it? Was it fairly good?

A: It was pretty good. I think in working with the Russian people on these committees, in some things, particularly in a lot of things where you use a lot of mathematics, they were pretty far along on the mathematical end of it. The laboratory was, I would say it would have met our standards. They were doing several things that I was quite interested in I think partly on this sub-surface flow business which nobody had done too much here. Although later on the Forest Service did more, I think it was the Forest Service. The sub-surface flow is a lot more noticeable in the little more rugged territory. One man did publish papers on it.

But I'd say there were some areas that they were probably behind us. They knew me from the synthetic unit graph. That was surprising. One time a Major Lovovich--he was here in Washington on some official business, but he was a hydrologist. He came to the Chief's Office for a visit with me. I don't know whether he visited anybody else or not, but he was interested in hydrology. But they were great on publishing their material. I've got a Russian book or two that they gave me.

Q: A present for you?

A: Yes.

Civil Works Division

Q: Well, let's go back to the Civil Works Division there after the war. I guess it was a division then or a directorate. Who was the chief of the Engineering Division then? Well, let's see. It wasn't Francis Slichter yet, was it?

A: Not yet, no. He's still living. Mary and Mrs. Slichter were good friends. We went back and forth, and they moved. She had trouble with her knees, and she had a sister in Kansas City. They moved there to be near her sister and her husband, and I think the sister died shortly--but anyhow, Mary Slichter died a few years ago. Slich went out to Utah where his son is. His son was from a first marriage that I think was originally out in Oregon. I let him know when my Mary, his wife was Mary, too, I let him know when my Mary died. I got a short note from him. He must be in his 90s. I'm 84, and I'm sure he is at least 90 by now.

Q: If you have an address for him I'd like to get that from you.

A: Who, Slichter?

Q: Yes, because I thought he was dead.

A: Okay. You want it tonight?

Q: Yes, tonight would be fine.

A: When we get through. But Johnson came after Slichter. Margaret Johnson lives up the street here. I'm trying to think who was ahead of Slichter. Shorty Hearn was Slichter's right hand man. Shorty was quite a character. He liked to play the stock market, I think. He went to Florida when he retired. We visited him down there once, but he's passed away since then.

I'd recognize the name right away, who was ahead of Slichter. I think it may have been R.W. Stuck. Because you know who the recent ones are, because after Wendell Johnson--Joe Stillwell, I think. Then a hydrologist was chief for awhile. He still lives out in Bethesda. Homer Willis. He's a good friend of mine. When he was out in the Ohio River Division, we used to go on field trips. He was in hydrology work out in the Ohio River Division.

Q: He is a nice guy.

A: He came in here and ended up being chief of the division for awhile. I'm thinking who was ahead of him for awhile. You're thinking more about the older ones?

Q: Yes, I'm trying to think about those folks. I need to do some more work on that. I'm just trying to get some names of people that you might have worked with.

A: When I was first there, there were three old timers there--McAlpine, Giroux, and Steele. They were the guys that you walked around. You didn't get into any trouble with them. Mr. Giroux got an exceptional civilian service award at the same time I did. Mr. McAlpine got several extensions of the compulsory retirement age. He played tennis, and he was still there for quite a while. A Mr. B.R. Wood was in charge of Flood Control. I haven't really thought of them for a long time.

Q: What I need to do is to get you some of the organization charts from the 1950s and see if we can add some names in there.

A: Yes. I believe Mr. Steele was head of the Structures Branch before becoming a special assistant. The head of the Geology Branch, Mr. Burwell, picked up a bug overseas some place that killed him. Later on, Mr. Bloor, head of the Structures Branch had a secretary that thought she should marry him, or that he should marry her. He had trouble. A lot of little things like that. There was something wrong with her.

Q: Interesting what happens in offices.

A: Yes.

Q: Now, Slichter came in with Lewis Pick, right?

A: From the Missouri River Division, yes. You know how the Pick-Sloan Plan got approved?

Q: Well, I know what I've read, but I'm not certain that that's accurate.

A: Well, quite often when there was a big flood the Chief would fly and overlook it. I got to go on several trips. But the one I'm talking about, I wasn't on that trip. But anyhow, there was a big flood in the Missouri River Division, and Pick took President Truman out there. I can't think of the name of the town where Truman was from. But it's a little town.

Q: Independence, Missouri.

A: Yes. He brought the name up and Pick showed him right away where it was on the map so from then on Pick got his way. That was the story I heard. Had you heard that?

Q: Well, I didn't hear it from that, but I knew that Truman was very much committed to Pick, very much in favor of Pick, but I didn't hear that particular story. What did you do in your branch on the Pick-Sloan Plan? Did you have any work on that.

A: Not directly.

Q: That was mainly a plan to prevent flooding, right? Some navigation, but mostly flood control.

A: Well, a lot of power.

Q: Well, power, I mean, yes.

A: Because all of the local people had organizations that got in on the power part of it.

Q: I mean I was thinking, it's a multi-purpose project, a whole series of projects. But the real inspiration for it was the flooding in places like Kansas City, St. Louis, and other urban areas.

A: Yes, there was a big flood control story. The upper dam had been -built a long time before.

Q: Fort Peck was built in the '30s.

A: Fort Peck, yes. Hathaway and, I think Hathaway, Cochran, and this Homer Willis I mentioned, they all came from the Missouri River offices, either in districts, the Kansas District, or the division office, into the Chief's office.

Q: But that's true for about 30 years isn't it, that that happens, from about the '40s to the '70s?

A: Yes.

Q: That a lot of those--Wendell Johnson was from MRD.

A: Wendell came from there, too.

Q: Lloyd Duscha was from MRD.

A: Oh, yes. Is he still?

Q: No, he's retired. He's been retired for about six years, five years.

A: I saw him a couple of years ago. I knew him to speak to him. I saw him at funerals and places like that. I saw when he got into the National Academy of Engineering. He became active in the Civil Engineering Section, tried to get them to reorganize some of their procedures. I don't know how he made out. I don't go to their meetings anymore.

Q: How much did things change between Pick and Wheeler? Were there any significant changes that you noticed or was it mostly project work?

A: Well, of course, in the beginning, my acquaintance with the front office was pretty slim. In other words, in Pick's day I didn't really ever get involved in anything that was going on, except what I would learn from Hathaway, so I don't really know how he operated. Later on I got to know the Chiefs. I always liked General Stratton. I saw his name just the other day. I got to know General Wheeler probably about as well as any. He was interested in Pakistan while at the World Bank. The World Bank had a big project, the Indus Water Plan.

Q: He was involved in a lot of that, wasn't he?

A: Yes, and Hathaway was, too. The Pakistan engineer that had worked on that plan, he'd been over to our office to talk to me so I got to know him fairly well. I think it was Pakistan that gave a big party that General Wheeler attended. Mary and I went to the party. Probably it was after the plan that they worked out had been approved. But, he was the one that gave me my Exceptional Civilian Service award. I've got a nice picture of him giving it to me in there.

Q: Let's see. What does it say here? That has to be Wheeler because, it is Wheeler, because it's 1946. That's Wheeler.

A: When was Reybold the Chief?

Q: Late November of '45. He left in November of '45. So that's Wheeler.

A: That's a xeroxed copy of one that I didn't have any extras of. That's Cochran, Hath, and I.

Q: Cochran on this side and Hathaway is there, right?

A: Yes, I'm in the middle.

Q: Okay.

A: Cassidy was also one of my favorites.

Q: Yes, Bill Cassidy?

A: Yes.

Q: He's the one Chief of Engineers we can't get to talk to us.

A: Is that right?

Q: For whatever reason.

A: Is that right? I'm trying to think of who was Chief when they had the dedication of the St. Lawrence Seaway.

Q: Itschner?

A: Yes. Mary and I flew up to the dedication on the plane with him.

Q: Because Sturgis came after Pick.

A: I don't remember him very well.

Q: Itschner was late '50s.

A: I don't know whether Itschner was there when Whipple got the computer business started. I'm not sure about the timing of that.

Q: I remember Hagen talked about Whipple pushing them in that direction and getting some of the first computers in the government. The new type computers,the IBM computers.

A: Yes.

Q: Okay. Do you remember any of the other key civilians in civil works when you were there?

A: In each field there were the heads of the various sections. They were all experts in their field. Burwell was a well-recognized man, the one that died from an infection he got overseas. Bloor, the head of structures went to the World Bank when he retired, so he was a pretty well-known man. Middlebrooks was a recognized expert on soils.

Q: A lot of those folks were going to the World Bank then.

A: Yes. I got to know, I think it was a Jim Casey in the real estate. Being involved in those regulations for other peoples' projects and stuff, I had a certain amount of contact with the Chief's legal advisor. Judge Kimball was really a fine man. I used to say that all lawyers should be drowned when they were born. Well, I've known two that that doesn't apply to. Kimball was one of them. I also talked to him about problems other than those reservoir regulations, but he always had a good answer for you.

Q: Could always provide the answer you needed?

A: **Yes.**

Q: The whole business of reservoir regulations. That was relatively new on the system wide basis, wasn't it?

A: That's right. It was sort of like I mentioned earlier, going around trying to get these Weather Bureau people to put their ideas down on paper so that it would be a matter of record. It was a little bit like that with the offices operating the reservoirs. We put out an engineering manual which I wrote on reservoir regulation. The requirements went out, they had to have a written operating procedure and get it approved. Now, I think everything is decentralized.

I remember one time, I think it was in the Missouri River Division during one of the floods, in order to get a little more storage they put sandbags on the spillway and

they really got chewed out for that. But that was the sort of thing we wanted to avoid. There is always a problem. You've got so much reservoir space and you have a flood. Well, should you use all of that space for that flood and then not have any left if one comes next week? Or how much should you use on the first flood, and how much should you save for future floods? So there's always a problem there in deciding how to operate. That was the thing we specialized in figuring out ways to do that.

The big problem, really the big problem, in reservoir regulation is the releases. When they make the studies and justify the economics of a project, they have a theoretical channel capacity downstream, so they make the study assuming that they can leave out X-amount of water. Well, after the project is built, if they leave out X-amount of water, everybody downstream yells, "Murder," because it's affecting them. So it's pretty hard to preserve your storage space. As soon as there are flood conditions, you should leave out all you can unless you're in a special situation where you're coordinated with some other project downstream.

In a normal situation, you leave out as much as you can so that you're saving all of the space that you can. With the people downstream screaming their heads off, it's pretty hard to do that. It's pretty hard to cause some damage downstream even though you're supposed to do that. The pressure gets pretty heavy not to leave out as much water as you should. And so then when the additional floods come in, you lose control because you've lost all of your space.

The people upstream scream for being flooded and the people downstream scream. It's just a situation where, I guess, it takes diplomacy as well as everything else to get the people downstream to recognize what you're doing. I'm sure some offices do that better than others.

Q: That's a very difficult thing to do. I mean people don't like to be flooded. They're sitting on those rivers and saying "Why did you build that dam up there to prevent floods and now you're flooding me."

A: Right. Sometimes you only have the one flood and so you have, after it's over and you put out this X-amount of water, space left in the reservoir. The people can't understand that.

Q: They don't understand there has to be space or you're in big trouble, right?

A: Yes.

Q: Now, that's a particular problem on a river like the Missouri, isn't it, where you have a cascade of big dams that have to be regulated?

A: The coordination has to be pretty good to get your maximum benefit. Some projects, I don't know that we have very many, but, occasionally, you have multiple-use storage which under certain conditions you fill it up for power. But also, during the flood season, you try to draw it down so that you'll have it available for flood storage. That gets a little more complicated, too, when the same space is used for different purposes. There is space allocated, or there used to be, for multiple-use. In other words, it's not strictly power, it's not strictly flood control.

Q: Yes, because in some you've got water supply, navigation.

A: Well, that was beginning to be a lot more significant towards the end of my service. The local people were partially paying for the, I guess in some cases they paid the full cost for space for water supply. That adds to the complications of operation. I see now in the journals here, I see paper after paper studying how to operate reservoirs. I often wonder what they're doing.

Q: Whether they've ever learned anything from what you guys did before?

A: I'm sure they're making studies on computers.

Q: I think it's all computerized.

A: Yes.

Q: I don't think there's any, some dams are all computerized-operated, I think. There's no operators on them anymore, that I know of. There may be maintenance people, but everything else, I think, is taken care of automatically. These very sophisticated programs they've developed.

A: The Missouri River Division before I left had worked out computerized operating procedures for all of their dams, and they had a big display there to show everything that was going on all of the time.

Q: Like the railroads, a control room?

A: Yes.

Q: They had a little problem there last year, two years ago, didn't they?

A: They had so much water. It did almost look like they were going to have it again this year, but I guess it didn't get so bad. I think the peak at St. Louis was 6-8 feet lower than it was back in, what was it '93?

Q: '93.

A: Yes. But people don't like to get two 100-year floods two years in apart. They can't understand that.

Q: Well, they ask you why they're 100-year floods, right? Or why you call them 100-year floods. But we'll get into that. Okay. So you did have some involvement with some of these multi-purpose projects that came in after World War II, as far as not only the regulation of the reservoirs but also in the planning, the survey part of it?

A: Oh, well, yes. We reviewed. . .

Q: Their plans.

A: In the office, I guess, the Reservoir Regulation Section theoretically would review the reservoir section of it, but I think routinely one you had a report to review, the engineers probably would review the whole thing, except maybe for certain specialties. In other words, the section wouldn't review just the reservoir operations, we'd review all of the hydrology for the spillway design and everything.

Q: Anything that had to do with the water part of it.

A: Yes.

Q: The water management part as well as the planning.

A: Yes.

Q: The computations as far as runoff and storage?

A: One of the main items was this Maximum Probable Flood for the design of the spillway, for the functional design of the spillway.

Q: I was going to ask you about that because apparently there's a lot of different ways that different organizations look at these things.

A: Oh, yes. The private sector took a real dim view of those probable maximum floods. They still kick it around. The National Academy of Engineering (National Research Council) about five years ago, set up a group to review the situation, and they published a report. Also about that time, Bob Buehler, who was in the same position I was down in TVA, got quite interested in trying to evaluate the value of life so as to make it an economic decision as to how big the spillway should be. There were always people and organizations trying to tear down the idea of using a probable maximum flood for spillway design because it cost money. The TVA, I'm sure, had a lot of dams that weren't quite up to the standard that the Corps was trying to produce. Same with the Bureau of Reclamation. The Bureau of Reclamation got onboard rather reluctantly. The TVA sort of did also, but used a different name.

Q: Apparently the TVA had a Standard Project Flood. Was there a definition?

A: Yes, that was part of the Corps' procedures, but the TVA definition was different from that of the Corps.

Q: Part of the Corps?

A: Yes.

Q: But the Corps went then to its National Probable Flood.

A: I am not familiar with that. We had the Standard Project Flood to serve some other purposes, mostly with deciding on the degree of protection that could be provided. The Standard Project Floods you tried to protect against when justified.

But Cochran developed this concept of a Standard Project Flood which often was half as large as the probable maximum flood. It was used for functional design of a project. The idea was to use it as a rating basis. In other words, your project still might only provide protection against 75 percent of the Standard Project Flood, but it was an index to work against for actual protection or whatever you were trying to accomplish.

Q: But the spillway would be designed for what, the probable maximum flood, which was a different criteria then.

A: Yes. It was to save the dam from failing. That's what it was for. As time went on, there was a congressional action, the Corps was to evaluate the safety of all of the dams in the country. They started working with the states. This was after my time. I've got one paper there which I though would be a big use in it, but they took another channel, another approach to determining what the standard, what the spillway design criteria would be.

But they did develop the idea that if there's a dam where it's failure wouldn't cause any appreciable damage downstream, well then you don't have to design for the probable maximum flood, although I don't think there are very many dams in that category. You never know. There's somebody down there camping, or driving along a road or something. Particularly in the private sector and the states, they set up some standards where the Standard Project Flood would be suitable for the spillway design and not the probable maximum flood.

Q: Well, I understand that's sort of what TVA does. They use the Standard Project Flood as the ...

A: Well, I don't think they would. I think they define it differently. I don't think they would argue that the Corps' Standard Project Flood would be adequate for a spillway design. I don't think they would get themselves in that box. I think they

probably, I don't know for sure, but I think their Standard Project Flood would be different than ours because I'm sure they would not, on a major project, now be satisfied with a flood half of the size of the one that's possible. No one would get themselves into that box.

Q: I don't know enough about it to...

A: Yes, well, as I say, I'm a little hazy, too, about what their position is. But I imagine there are still a lot of people that think our probable maximum flood is absurd. But every so often there is a flood that happens that converts a lot of people, but it doesn't necessarily convert them all.

Q: I guess Teton Dam is one of those, the one that went out in the '70s in Wyoming? That had one of those situations where it wasn't big enough to. ..

A: A lot of organization are gradually upgrading existing reservoirs, improving their capacity.

Q: Even putting, what, higher...

A: Well, generally they combine it with increasing spillway capacity and adding some additional storage.

Q: Adding freeboard to the dam to get more?

A: Beg pardon?

Q: They add more to the dam to give it greater capacity or something?

A: Yes, they could increase the spillway capacity when they're rebuilding the dams. Then at the same time, if they can get more storage--I just read an article the other day where some old dam down in the Southwest, I don't think it was a government dam--was reworked. I think it was owned by a local water supply.

Q: What, Roosevelt Dam?